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Front bonnet system

The invention relates to a front bonnet system of a motor vehicle with the features according to the precharacterizing clause of claim 1.

When motor vehicles collide with pedestrians, the front portion of the motor vehicle forms an impact surface which has to be provided with a defined flexibility in order to avoid or at least to reduce injuries to individuals. The central region of the front bonnet, which is of planar design, may be designed such that it is correspondingly elastically or plastically deformable.

In the driving mode, in which the front bonnet is closed, the latter rests on corresponding supporting points of the surrounding body parts, such as the wing, front subassembly or the like. In the region of the supporting points mentioned, there is only slight vertical flexibility. For example, in the event of a vertical head impact in this region, the lack of flexibility may give rise to undesirably high impact accelerations. In addition, in the case of vehicles with a front engine, increasingly stringent demands regarding the absorption of noise require effective countermeasures in the region of the front bonnet. In addition to a planar lining of the engine bonnet with a suitable sound-absorbing mat, a means of absorbing noise may also be required in the region of the encircling front bonnet edge.

Front bonnet systems are known, in which the body-side supporting points for the front bonnet are designed flexibly in the vertical direction to reduce the consequences of an impact. For adequate flexibility, a

corresponding construction height is required which is not always provided in the constricted parts of a front portion of a motor vehicle. Measures for absorbing noise and for sealing the front bonnet in the region of its edge may adversely affect the desired flexibility in this region.

The invention is based on the object of developing a front bonnet system of the generic type in such a manner that the front bonnet, in the region of its edge, has improved impact flexibility without having an adverse effect on the sealing of the edge.

The object is achieved by a front bonnet system with the features of claim 1.

For this purpose, it is proposed that, in order to form the flexible, body-side supporting points, a linearly encircling supporting strip with a sealing strip situated between the supporting strip and the front bonnet is provided. In this case, the front bonnet has, on its side facing the supporting strip, an absorption strip which encircles it in a manner corresponding to the body-side supporting strip and can be brought to bear against the sealing strip. When the front bonnet is closed, the absorption strip, the sealing strip and the supporting strip are pressed onto one another, with the closing forces or counterforces occurring leading in conjunction with the associated, elastic deformation to a reliable, encircling sealing-off of the engine bonnet from the body parts situated around it. At the same time, the absorption strip and supporting strip which is flexible in the vertical direction form a joint potential for deformation with an overall high deformation distance. If the abovementioned parts are appropriately mechanically configured, a large amount of impact energy can be absorbed over an overall large deformation distance, as a result of which impact

accelerations which occur are kept to a correspondingly low level. In customary operation, the encircling sealing strip on the flexible supporting strip provides reliable sealing and contributes to the absorption of noise without restricting the deformation distance, which can be achieved structurally, of the absorption strip and supporting strip.

In an advantageous development, the front bonnet has, at least over a partial region of its outer edge, an outer region reaching from the absorption strip as far as the outer edge, a clearance extending over the width of the outer region in the vertical direction as far as the supporting strip situated below. This design avoids, in the event of a vertical impact, the designated deformation distance being limited by the bonnet outer edge striking against a body part situated below it. An overall deformation distance is available which is composed of the individual deformation distances of the absorption strip and of the flexible supporting strip.

In an expedient development, the supporting strip has a doubly bent, approximately Z-shaped cross section with a free limb for receiving the sealing strip and a retaining limb secured on the adjacent body part. In this case, the free limb lies in the vertical direction below the retaining limb. The effect achieved by this arrangement is that, in the closed state of the bonnet, the cross section of the absorption strip lies approximately laterally next to the central part of the Z-shaped cross section of the supporting strip. An overall small construction height of the flexible system comprising the absorption strip, the sealing strip and the supporting strip is produced.

In this case, the supporting strip is advantageously manufactured from plastic. Given a suitable structural

design, an elastoplastic behavior of the supporting strip in terms of flexibility that reduces the impact accelerations can readily be obtained.

To improve the sound-absorbing effect, the absorption strip is advantageously coated with a sound-absorbing material on its side facing the sealing strip. For this purpose, the sound-absorbing material is in particular formed by a sound-absorbing mat which is fitted on the inside of the front bonnet and is drawn around the absorption strip. In the closed state of the bonnet, the sound-absorbing material bears in a planar manner against the sealing strip. The overall elastically flexible supporting system of the front bonnet leads in this case to a uniform, planar bearing with correspondingly good sound-absorbing effect without the desired elastoplastic behavior in terms of flexibility in the event of an impact being impaired.

To produce a defined contact pressure with good plastic energy absorption behavior, the absorption strip expediently has an approximately trapezoidal cross section, the narrow side of which can be brought to bear against the sealing strip.

The absorption strip is advantageously formed from a rigid synthetic foam. In the event of an impact load, the foam bubbles of the rigid foam collapse in the manner of a cascade, as a consequence of which a high energy absorption with comparatively low force peaks is provided over the entire deformation distance. In an advantageous alternative, the absorption strip is formed from a plastic hollow trough. The plastic hollow trough can be produced with little outlay in terms of manufacturing and is easy to fit. From the onset of a certain limit force, the cross section collapses and results in a desired energy-absorbing flexibility. Below the limit load, the hollow cross section of the

plastic hollow trough has an elastic flexibility. Height tolerances in the encircling sealing system can be correspondingly readily compensated for. Smaller additional loads can readily be absorbed without the absorption strip being damaged.

Exemplary embodiments of the invention are described in more detail below with reference to the drawing, in which:

fig. 1 shows, in a diagrammatic cross-sectional illustration, a detail from the front region of a motor vehicle with a rigid foam absorption strip and a supporting strip which is Z-shaped in cross section,

fig. 2 shows, in a diagrammatic illustration of a longitudinal section, a variant of the arrangement according to fig. 1 with an absorption strip designed as a plastic hollow trough.

Fig. 1 shows a detail of a diagrammatic illustration of a section transversely with respect to the direction of travel through the front region of a motor vehicle. The front region has a front bonnet 1 and body parts 2 and 3 (fig. 2) encircling around the front bonnet 1. The body part 2 shown by way of example in fig. 1 is a front wing with a wheel house 25. A supporting strip 5 which runs at least partially linearly around the opening closed by the front bonnet 1 and which forms a supporting point 4, which is flexible in the vertical direction, for the front bonnet 1, is secured on the body part 2.

In the exemplary embodiment shown, the supporting strip 5 is manufactured from plastic and has a doubly bent, approximately Z-shaped cross section with a free limb

12 for receiving a sealing strip 6 and with a retaining limb 13 secured on the adjacent body part 2. The free limb lies in the vertical direction below the retaining limb 13.

The front bonnet 1 comprises an outer shell 20 and an inner shell 21, with, on the front bonnet 1, on its side 7 facing the supporting strip 5, an absorption strip 8 which encircles it in a manner corresponding to the supporting strip 5 and can be brought to bear against the sealing strip 6 being provided. The absorption strip 8 is coated on its side 14 facing the sealing strip 6 with a sound-absorbing material 15 which, in the exemplary embodiment shown, is formed by a sound-absorbing mat 16 which is fitted on the inside of the front bonnet 1 and is drawn around the absorption strip 8. The absorption strip 8 has an approximately trapezoidal cross section with a narrow side 17 and, in the exemplary embodiment shown, is formed from a rigid synthetic foam 18.

In the closed state of the front bonnet 1 that is shown, the latter bears with the narrow side 17 of the absorption strip 8 against the sealing strip 6. The cross section of the sealing strip 6 is shown undeformed, the absorption strip 8, the sound-absorbing material 15, the sealing strip 6 and the supporting strip 5 being elastically deformed under the action of a closing force, illustrated by an arrow 22, and a counterforce, indicated by a corresponding arrow 23, in such a manner that the narrow side 17 of the absorption strip 8 bears against the sealing strip 6 in a reliably sealing manner.

Under the action of a vertical impact force 24 in the region of an outer edge 9 of the front bonnet 1, the absorption strip 8, the sound-absorbing material 15, the sealing strip 6 and the supporting strip 5 yield in

the direction of the impact force 24. In this case, a plastic deformation occurs in particular in the region of the absorption strip 8 and the supporting strip 5 in order to absorb the impact energy. Given an appropriate configuration of the rigid synthetic foam 18, the latter can collapse over virtually the entire cross-sectional height of the absorption strip 8 with a corresponding, plastic distance in terms of flexibility. In addition, the supporting strip 5 deflects downward in the vertical direction, with an elastoplastic cross-sectional deformation occurring. In the case of correspondingly high deformation distances, the cross section of the supporting strip 5 may even be entirely knocked through downward. The energy absorption distances of the absorption strip 8 and of the supporting strip 5 are added up in the process.

In the partial region shown in fig. 1, the front bonnet 1 has an outer region 10 reaching from the absorption strip 8 as far as the outer edge 9, with a clearance 11 extending over more than the entire width of the outer region 10 in the vertical direction as far as the supporting strip 5 situated below. Given appropriate deformation of the absorption strip 8 and the supporting strip 5, the front bonnet 1 can yield in the vertical direction without obstruction at least until the outer edge 9 comes to bear against the retaining limb 13 of the supporting strip 5.

Fig. 2 shows, in an illustration of a detail, a variant of the arrangement according to fig. 1, a longitudinal section corresponding to the direction of travel indicated by the arrow 26 being selected for illustration. The front bonnet 1 rests with its absorption strip 8 on the sealing strip 6 of the supporting strip 5. The supporting strip 5 is secured on a body part 3 in the form of a front subassembly (indicated). In the exemplary embodiment shown, the

absorption strip 8 is formed from a plastic hollow trough 19 with an approximately trapezoidal cross section. In the remaining features and reference numbers, the arrangement according to fig. 2 corresponds to the arrangement according to fig. 1.